

# Environmental Restoration Plan

## Soil Contamination and Remediation

With a history of heavy-industrial use dating back over 125 years, land in the Upper River corridor has absorbed industrial wastes, many of which could pose serious threats to human health. Fortunately, steady advancements have been made in regulatory requirements for identifying contaminants and techniques for cleaning soils. The Upper River Master Plan includes a list of sites of known contamination in the Appendix. As redevelopment proceeds more thorough investigations will be needed. The Plan responds to concentrations of pollutants with new, higher-revenue-producing land uses and suggests possible remediation techniques.

### Pollution concerns

Scrap metal yards, oil tanks, former foundries, railroad yards, printing plants, piles of coal and salt: all of these potential sources of pollutants are found along the Upper River. Contaminants identified from government sources, including the Minnesota Pollution Control Agency (MPCA), are those commonly generated by industry.

#### *Known pollutants*

- Petroleum products
- Solvents
- Lead, and other heavy metals
- PCBs (polychlorinated biphenyls)
- VOCs (volatile organic compounds)
- PAHs (polynuclear aromatic hydrocarbons)

Contact with these contaminants can be made at ground level from soils, or through evaporated or fine particles in the air. Lead has been shown to damage nervous systems and other chemical pollutants are suspected carcinogens. Children are particularly vulnerable to health problems associated with soil contaminants, because they are closer to the ground and their bodies are still developing.

### Groundwater

Concerns about contamination are not limited to soils because some pollutants can reach the water table. Once pollutants, such as diesel fuel, descend to the level of groundwater, the hydrologic system can cause them to migrate. Given industrial sites near and on the riverbank, migration into the river water can be the quick result. Metals too can simply wash off into the river, enter storm drains, or leach through soils into groundwater. The Mississippi River supplies drinking water to the City of Minneapolis, with hundreds of other communities downstream. While the City Water Works ensures a supply of drinking water to residents, aviary, terrestrial, and aquatic wildlife drink directly from the river. Contamination of the riverbed, constantly stirred by dredging, barges and recreational boats, add to long-term consequences

and the need to limit sources that pollute the ground and surface waters.

### Analysis of Specific Areas

The MPCA maintains a database of known sites of contamination, and works with property owners to identify sites and monitor cleanup activities. Sites are listed as “active,” meaning that cleanup is still necessary, or “closed,” signifying that the MPCA is satisfied with the level of remediation. An important classification is listed under the acronym “LUST” sites, for “Leaking Underground Storage Tank.” Contamination identified can be from prior uses and owners, current uses and practices, or in some cases, migrated to the site via groundwater hydrology.

A cross-referencing of databases compiled by the MPCA with geographic representation revealed areas with the greatest concentration of MPCA sites and LUSTs. The greatest concentration of known contamination sites is on the west bank, south of Lowry. Pollution of these sites is due to past or present businesses, on-going practices or single events. For instance, solvents at the site of a former printing plant are impacting groundwater; heavy metals, VOCs, PAHs, and PCBs have contaminated soil and groundwater at the current site of a scrap metal yard; and a ruptured line spilled diesel fuel at the City’s Public Works sanitary truck garage. Additional large areas of concern are between Broadway and Plymouth on the west bank, and land east of St. Anthony Parkway.

An encouraging result of the overall analysis is that many portions of the Upper River corridor seem to have relatively minor levels of contamination. The research shows no MPCA or LUST sites at the Upper Harbor Terminal. Most of the east bank is also without reported sites. Caution must be used though in drawing conclusions from this level of investigation. A complete Phase One land-use history research and Phase Two soil borings should be undertaken before public acquisition of any sites.

### Levels of cleanup

Differing levels of soil remediation are required based on the proposed use of land with known contamination. The highest level of decontamination is required for residential uses. The cleanup level of sites to be used for parks are negotiated with the MPCA in response to specific conditions; generally this cleanup is less restrictive than for residential uses, provided that any contamination is not migrating and the site is capped so that no contact with soil pollutants occurs at ground level. Sites where light-industrial or commercial structures are to be built are held to a lower standard of cleanup, since concrete pads and flooring will reduce contact with soils.

The Upper River Land Use Plan responds to a concentration of soil contamination by proposing high-density residential and office uses, designated as the Mississippi Promenade District. This density of development implies apartments and condominiums. The bank of the river is capped with a concrete plaza. This recommended residential use will require extensive and expensive cleanup. The intensity of development will help to payback some of the remediation cost. In addition, digging deep foundations for large buildings will remove contaminated soils to be safely disposed. Most other redevelopment areas seem to offer few impediments to the planned uses. The MCDA will continue its program for soil cleanup in the North Washington Industrial Park, successfully encouraging new construction.

### Decontamination Technologies

Exciting progress is being made in the field of soil remediation. On many sites contamination can be addressed *in situ*, that is without removing the soil. For instance, steam can be injected into soils holding petroleum or solvents, with the vapor then extracted, condensed, and removed from the site. This technique is being used to great success in the Central Riverfront. Heavily contaminated sites, for instance former scrap yards, are likely to require some excavation to remove metals and other pollutants. Capping is a technique to introduce a layer of clean soil, providing a barrier between contamination and the ground level. On some sites capping may also include installation of an impervious surface, or subsurface membrane, to reduce penetration of water into deep layers of contaminated soils; however this technique should only be used in the most contaminated areas.

Over the period of implementation, innovative techniques are sure to be developed for remediation. Current technologies on the cutting edge include injecting soils with materials that attract microorganisms to break down complex organic compounds into harmless chemicals. An important point is to recognize that the Upper River *can* be cleaned up with existing technologies and that it *should* be cleaned up to avoid migration of pollutants into the Mississippi.



# Stormwater Retention and Filtration

The Mississippi River drains a watershed that includes a majority of the land mass of North America. The river is much more than a meandering channel within defined banks, it is in a sense all of the water flowing over and under the land, gathering in large and small tributaries to the great stream.

## Existing System

Still within a few hundred miles of its origin, the portion of the Mississippi in Minneapolis known as the Upper River, is increased by two creeks: Shingle Creek near the Camden Bridge and Bassett Creek south of Plymouth. While the entrance of the two creeks is visible, water also flows to the river in simple cascades over banks during rainfall, and through a system of 33 stormwater outfall culverts. Many of these drains enter the river below water level; all collect water running off streets, yards, and buildings in the catchbasins seen along curbs.

Before the advent of sanitary sewers and treatment plants, stormwater and human wastes both flowed into the Mississippi, which was conceived of as the largest drain in the system. Today, a separate system of stormwater sewers carries run-off to the river, yet the water still picks up trash and pollutants along the way. Oil, anti-freeze, lawn fertilizer, animal wastes, leaves, paper, sand, road salt, and many other solid and dissolved materials enter the flow. Impervious surfaces increase the volume of run-off, and reduce the filtering effect that land can have if water is able to percolate through to the level of groundwater. Currently, no water quality improvement ponds exist adjacent to the Upper River.

## A 21st-Century Stormwater System

The Upper River Master Plan includes recommendations for improving the ecological function of the river edge and retaining and filtering surface run-off. Riverbank stabilization and revegetation will create a shoreland buffer that filters trash, slows run-off, and provides areas for groundwater recharge. Treating water at the river edge, however, is not sufficient to meet standards for stormwater retention in areas of new development. The Plan recommends stormwater treatment that meets best-practice standards for new development, even though these standards are not mandated in the area because of preexisting urbanization. It is also recommended that, as the Plan is implemented, the most up-to-date techniques for improving water quality be installed to create a twenty-first-century infrastructure for cleaning storm run-off.

### Water quality improvement goals:

- Intercept trash from surface run-off
- Remove sediment and particulates
- Detain heavy metals
- Reduce nutrient levels
- Increase dissolved oxygen

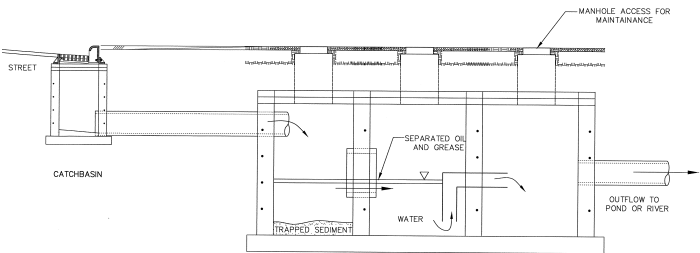
## Sub-Watersheds

Most of the Upper River is part of the Middle Mississippi Watershed, which drains approximately 13,620 acres. Shingle and Bassett Creeks also have designated watersheds to the north and south of the Middle Mississippi. Sub-watershed districts are related to storm sewer infrastructure, and also include areas where water runs directly from banks into the river. The Master Plan focuses on improving water quality in the sub-watershed districts within the Upper River redevelopment areas, including the west bank and the redevelopment proposed for the Grain Belt area.

## Run-off Interception

Infrastructure placed in curbs and under streets is used to intercept stormwater running on impervious surfaces. Interception can also be accomplished utilizing vegetated swales or depressions, for instance in parking lots, which will collect and begin to filter the water. Swales can be combined with infiltration basins or trenches, which are excavated and filled with coarse aggregate. Run-off is stored in the voids between aggregate, and then allowed to seep into the surrounding soil.

Catchbasins collect water at curbs and should also be combined with filter devices that separate petroleum products and grit. Separate grit chambers should be used in areas close to sources of pollutants. Oil and grit separators need to be cleaned out at least twice a year to maintain their effectiveness.



*A typical oil and grit chamber has three chambers. Sediment settles in the first chamber. Oil and grease float on the permanent pool of water and are kept from discharging by a submerged outlet between the second and third chambers.*

## Run-off Interception Techniques

- Vegetated Swales
- Infiltration Basins
- Catchbasin Filters
- Grit Chambers

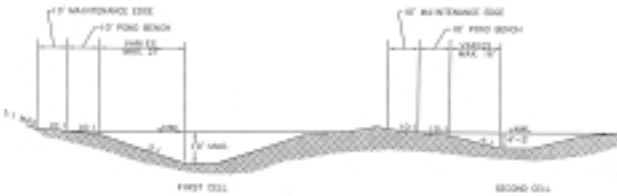
## Area-wide Ponds

The Master Plan proposes establishment of a system of ponds serving the Upper River redevelopment areas, rather than requiring each development project to create its own ponds. This area-wide system will result in consolidation of ponds into the desired areas, and produce more satisfactory aesthetic and water quality improvement results. Costs for constructing and maintaining stormwater ponds should be shared amongst parcel owners contributing run-off to each sub-watershed district.

Water Quality Ponds

In order to meet Nationwide Urban Run-off Program (NURP) standards, the Plan proposes areas for retaining and filtering stormwater. Sub-watersheds areas are overlaid on the redevelopment areas with recommended sizes for the ponds given.

Typical ponds are constructed with one or two cells. A one-cell pond will improve water quality by slowing run-off and allowing sediment and other solids to settle out of the water. A two-cell pond system combines the benefits of a retention area with a constructed wetland. These constructed wetlands provide additional cleansing action, through the uptake of nutrients by wetland plant species. Bacteria that live on roots and stems of species such as bulrush and duckweed also break down organic pollutants into simpler, less harmful compounds.



Two-cell pond

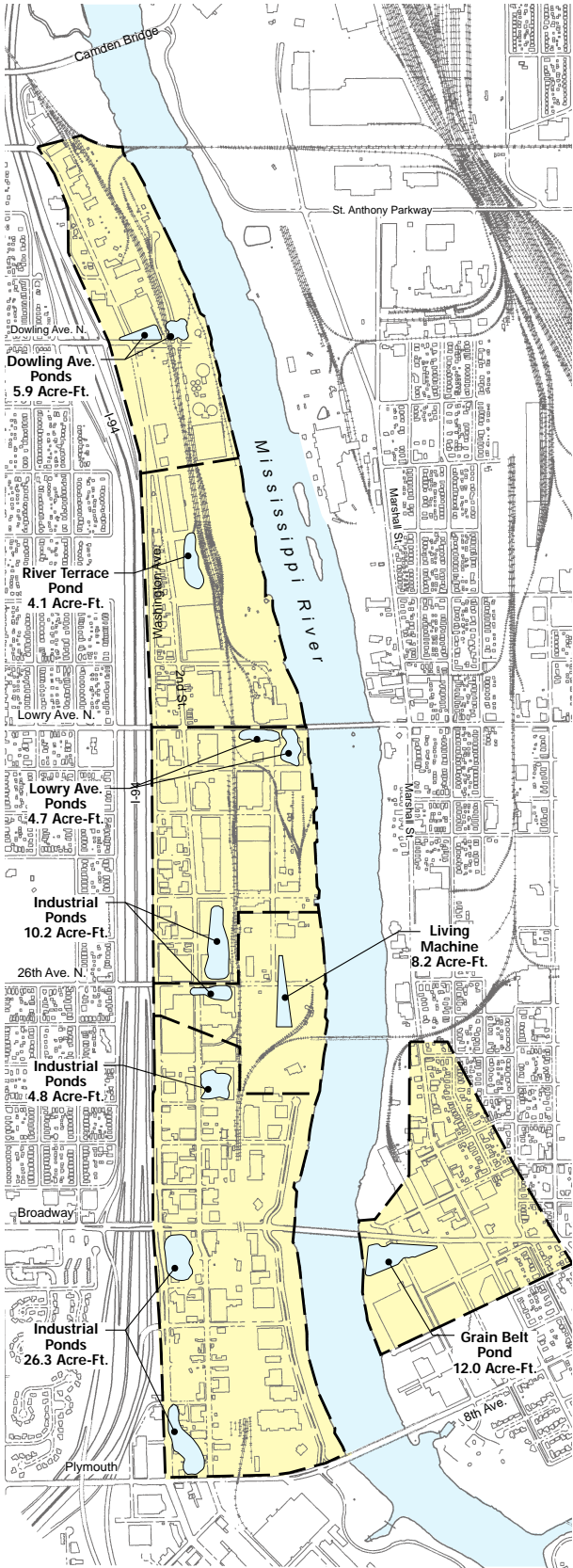
Benefits

Pollutants reduced by retention and filtration techniques can be placed in the following broad categories:

- Suspended Sediment
- Trace Metals
- Phosphorus
- Nitrogen
- Bacteria

Suspended solids, such as sediment, make run-off water look clouded, while trace metals, such as lead, pose health hazards to animal life. Nitrogen- and phosphorus-based pollutants are generated by lawn fertilizers and decomposing organic matter; when entering the river they increase the nutrient level leading to algae and bacteria growth, and thereby reduce dissolved oxygen which aquatic species need to breath. Retention ponds remove large percentages of these pollutants, with benefits increasing the longer the water is detained.

In addition to water filtration areas included in the Land Use Plan, it is recommended that a series of “Industrial Ponds” be constructed in the North Washington Industrial Park as part of the ongoing redevelopment of that area.



Recommended water quality ponds with sub-watershed districts. An acre-foot is a measure equal to a 1-foot-deep pond covering an acre. Typical retention ponds average 6 feet in depth, so a recommended pond of 12 acre-feet would have a surface area of approximately 2 acres.

# Water Filtration Parks

Retention and filtration of stormwater run-off is a crucial component of an ecosystem approach to improving the Upper River. However, sites devoted to improving water quality should be designed and constructed, not as simple exercises in engineering, but as additional amenities complementing the river and adjacent redevelopment. The concept of water filtration areas as parks has reached an exciting level of development, with stormwater ponds utilized as water bodies within open space settings designed for human interest and education.

The Master Plan combines no-build zones reserved as view corridors to the river and downtown with Water Filtration Parks. These filtration parks are connected to the overall parks system, and in most cases should be designed to blend together seamlessly. However, most of the land utilized for ponding would not be owned by the Minneapolis Park and Recreation Board, but rather should be outlots within private development sites set aside for ponding. An option for future consideration might be the establishment of a public-private partnership to develop ponds and allow public access.

## Features

Water quality ponds have such great potential as park features precisely because they store water, which has been a traditional part of park and pleasure garden design since their origins. The ecological, regulatory, and aesthetic converge, with a sharing of costs for pond construction between what is required to meet standards and the addition of certain public amenities to produce useable parks. In addition to retention ponds, other basic features should include:

- Wetland plantings, for increased ecological and aesthetic effect
- Observation platforms
- Trails
- Educational signage

## A Model

As concern about water quality grows, municipalities around the globe have recognized the opportunity to combine stormwater ponds with parks. Many examples could be listed, but one new park is so outstanding that it provides the best model for a high-quality water filtration park. This park is the “Living Water Garden” in Chengdu, China, winner of the 1998 “Top Honor Award” from The Waterfront Center. The Living Water Garden transformed a polluted riverfront site in a highly urbanized area into an amenity that both cleans river water and educates visitors about the processes used. The park combines the finest in design—it is *shaped to resemble a fish*—with excellent engineering, utilizing an advanced constructed wetlands system to treat the water. Flowing through a series of ponds, or tanks, the water is purified by settling, anaerobic microorganisms, aeration, and a variety of wetland plants.



**“Living Machine” Wetland Garden**

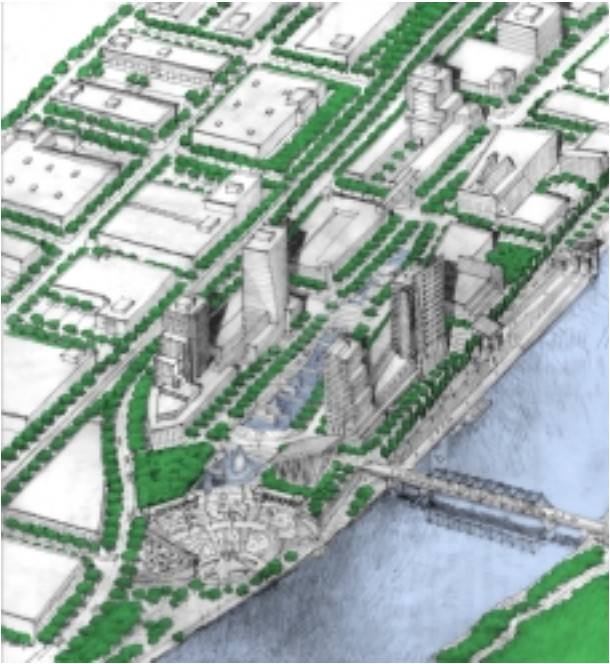
An advanced constructed wetlands system is applied to the “River City” site in the Upper River Master Plan. Labeled the “Living Machine,” after wastewater systems developed by John and Nancy Todd, the system utilizes inert filters and biological processes of living plants and microscopic animals to cleanse stormwater. The urban design of the water filtration park complements the surrounding high-intensity uses, collecting run-off from the area’s impervious surfaces. The concept is the same as the wetlands park in China: a system of settling tanks and filters are combined with concrete-lined wetland “ponds.” On this site, impervious tanks or “ponds” are recommended given the possibility of remaining soil contamination—water might only pick up more pollutants if allowed to filter through to the level of groundwater.

The primary filters and settlement tanks remove grit and solids in the water, while anaerobic microorganisms in the tanks break down organic pollutants. The water would flow from one tank over a series of cascades, the splash and aeration increasing dissolved oxygen levels. The secondary filtration is provided by a series of ponding tanks with wetland species, and associated microorganisms, taking nutrients out of the water as they grow. The China system harvests wetland plants grown in the nutrient rich water for use as fertilizers and feed. The “Living Machine” would also require periodic maintenance. During winter the flow would slow or stop, as does the flow of surface run-off.

In addition to water quality benefits, the “Living Machine” would provide an educational resource informing citizens about efforts and techniques utilized to clean stormwater. Signage would describe the various filters and plant species, and the improvements that each stage makes to the water quality. Finally, the last phase of treatment includes a fish pond, which could have ornamental fish or river species, leading to a large pool and fountain above the Skyline Amphitheater, providing a final burst of aeration to increase oxygen content before the water is allowed to flow to the river.

**Other Water Filtration Parks**

Of course not every water filtration park should be as elaborate as the proposed “Living Machine.” Most parks would consist of simple one- or two-cell ponds, with wetland plantings, in a naturalized setting. Some might include aeration fountains or other devices to improve water quality. New techniques are sure to be developed over the implementation period of the Upper River Master Plan, yet the goals of improving water quality, creating wetland habitat, and education will remain constant.



*“Living Machine” Concept*

# Riverbank Stabilization and Restoration

Over the 125 years of industrial use of the Upper River, the condition of the river banks has been substantially altered. Vegetation has been cleared and slopes excavated or filled to provide easier access for the movement of materials. Industrial river edge treatments currently found include: barge bulkheads, rock riprap, and steel sheetpile. Some of these structures are necessary to reduce further erosion of banks on properties in industrial use, however, many other sections of bank have been needlessly degraded or simply neglected. In order to improve the ecological function and aesthetics of the Upper River, the Restoration Plan recommends the application of soil bioengineering techniques to stabilize and revegetate the river edge.

## Existing Conditions

A comprehensive survey of bank conditions along the Upper River is included in the Appendix. In general terms, the main naturally occurring problem is toe erosion, that is the lower bank is being undercut in certain sections by river action causing the upper bank to collapse. Human-made impediments include retaining structures at the edge, such as rock riprap or sheetpile, many of which are in deteriorating condition. Transfer of bulk materials at barge docks preclude bank vegetation, with open storage of materials also creating areas without vegetation at many places along and above the bank. Some of these denuded areas are caused by the nature of the activity on the site, other deteriorated banks are the result of abandonment and indifference. Careless clearing of vegetation to create views from private residential lots is also a problem.

Besides a variety of human constructs, the Upper River also has a number of different types of slopes:

- Flat slope, with well vegetated low banks
- Moderate slope, with construction debris and vegetation
- Large shallow bank failures, with little vegetation
- Steep slope, well vegetated
- Surface sloughs, or gullies with sparse vegetation

Much of this variety is a remnant of original topography—in general the east bank is higher and steeper—while the rest is the result of human alterations.

## Bank Stabilization and Restoration

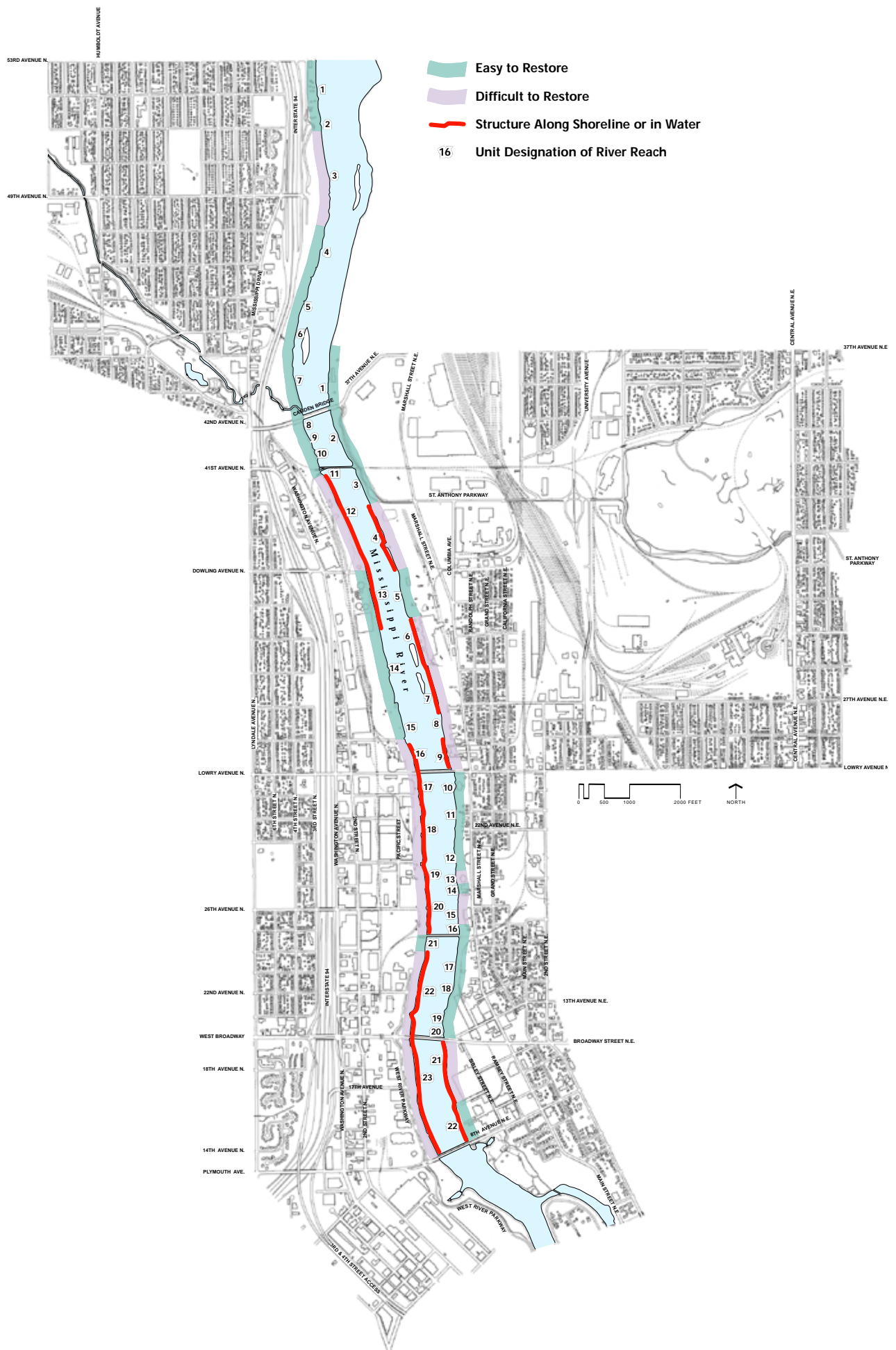
The Mississippi River is a critical connecting element in the surrounding natural and urban environment. The riverbank acts as an important corridor for the conservation of plant species and movement of wildlife. In addition, the riparian zone where the river and land meet is a crucial last chance to slow and filter water running over banks into the river. The overall objective for restoring the riverbank is to introduce new plantings that will provide an integrated series of benefits.

### Bank restoration goals

- Stabilize the mechanics of slopes
- Reduce soil erosion
- Improve water quality
- Create and connect wildlife habitat
- Enhance riverbank aesthetics



Example of soil bioengineering using a live fascine technique.



*Riverbank analysis shows difficult and easy reaches to restore. In general, areas with structures along the bank are more difficult to restore. Numerals refer to specific locations analyzed for existing conditions, with an inventory in the Appendix.*

**Soil bioengineering concepts and techniques**

The Plan recommends utilizing soil bioengineering techniques to restore vegetation to the banks of the Upper River. Soil bioengineering is a living technology consisting of plant structures that initially add stability to banks through live stem stakes, and over time, through root systems. Roots consolidate soil particles as a mass, thus reducing the potential of the bank to slump or collapse. Growth of plant stems and leaves creates a shoreland buffer that reduces run-off velocities, cleanses the water by collecting sediment, redirects flow, and offers surface erosion control protection. Use of native species for bioengineering will enhance biological diversity and complement the landscape restoration and wildlife habitat recommendations.

Four bioengineering methods are recommended for the Upper River:

- Joint planting
- Live fascine
- Brushmattress
- Vegetated geogrid

Details on which techniques should be applied to specific sections of river bank are included in the Appendix.

**Joint Planting** is a system that installs live vegetative stakes between the joints of previously placed riprap rock. As the plants grow, a mat of roots spread beneath the rocks, increasing the stability of the existing structure and placing a new filtration buffer on the surface. The technique is simple and low cost, but produces highly effective ecological and aesthetic results.

**Live Fascine** structures are bound bundles of live cut branches. They are tied together securely and placed into trenches along streambanks, upland slopes, wetlands, or in gullies. The live fascine bundles are typically installed with live stakes and dead stout stakes, and often used in conjunction with erosion control fabrics. Plantings follow contour lines in dry areas, breaking up slopes into a series of shorter slopes separated by benches. Mini-dam structures are created capable of holding soil on slopes. The technique provides surface stability, which speeds the natural process of vegetation.

**Brushmattress** is a system that combines living structures to form an immediate protective surface cover on riverbanks. Live stakes, live fascine, and a branch mattress cover are installed, resulting in rapid growth of heavy vegetation.

**Vegetated Geogrid** is useful for the reconstruction of steep fill slopes. This technique involves the installation of live rooted plants, branch cuttings, and soil lifts wrapped with geogrid, in regular arrays in the face of reconstructed slopes. The branches are oriented perpendicular to the slope, and when combined with geogrid material, offers significant reinforcements to soils. This method is most useful for upland slopes and riverbank to solve complex, deeper instability and higher run-off velocity conditions.

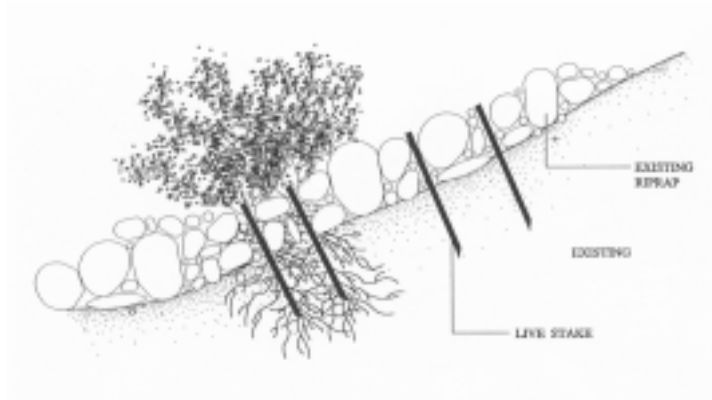
**Benefits**

Application of these techniques to selected sites along the Upper River will vastly improve the ecological function of the riverbank: vegetating denuded sites, creating a shoreland buffer for filtering run-off, stabilizing slopes, reducing erosion, and connecting habitat for wildlife in the river corridor. The aesthetic effect of implementation will be dramatic, with luxuriant growth along both banks of the Mississippi, softening and greening the river landscape for park and trail users and recreational boaters alike.

**Upper River sites and recommended soil bioengineering techniques.**



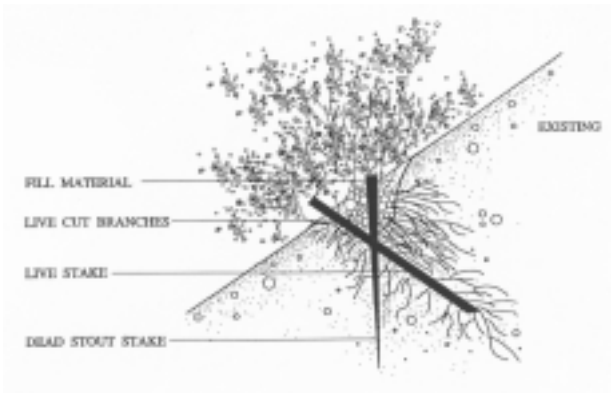
Riprap bank



*Joint Planting*



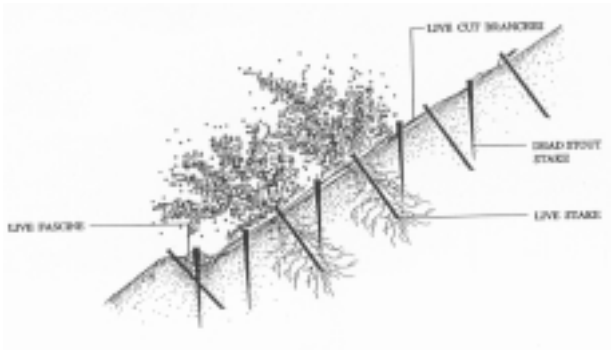
Very high and steep sloughing slopes



*Live Fascine*



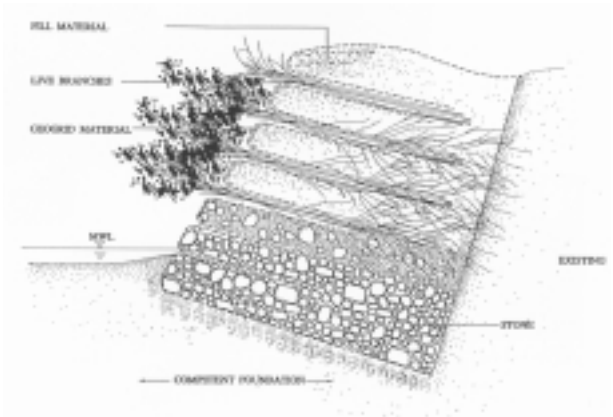
Open site with concrete and rock bank



*Brushmattress*



Toe erosion, construction fill, and overwash



*Vegetated Geogrid*

# Landscape Restoration and Wildlife Habitat

Improving the ecological function of the Upper River area is a primary objective of the Master Plan. Creation of over 90 acres of new parkland is proposed, with an additional 16 acres reserved for Water Filtration Parks. In order to maximize the potential of these new open space amenities the Restoration Plan recommends an ecosystem approach that will recreate areas of native vegetation and provide habitat for a wide variety of wildlife.

The ecology of the Mississippi River can be considered at a number of scales, from the global, to the regional, local, and specific sites. Recommendations recognize the Upper River as a unique landscape along a stretch of a much larger river, connected to the ecology of the region up and down the river corridor, but also as a place within an urban environment where restoration treatments will be set in a mosaic of human activity.

## Historic Vegetation

The area above St. Anthony Falls is a transition zone between the Northern Hardwood Forest and Tall Grass Prairie ecotypes. During the period following the end of the last Ice Age, the present structure of the Upper River, its course, topography, climate, and soil conditions, was set. Soil and geological surveys show that the Upper River is composed of terraces, created as the river receded in width, and outwashes deposited as the river shifted course. In general, soil conditions are deep sand with a layer of organic material at the surface. Upland soils are porous, retaining little water near the surface, creating conditions conducive to sustaining an oak savanna ecotone. Fire swept by prevailing westerly winds played a role in creating oak savannas, because white and burr oak are able to withstand repeated burning, while other trees are consumed. Prairie species benefit from periodic fire, creating an open savanna with copses of oak surrounded by grasses and flowers. Wetter soil conditions at the river edge, and in the floodplain, allowed other species such as cottonwood and willow to survive fires, especially on the east bank, with the river acting as a fire break.

## Landscape Restoration

Within the Parks Plan large areas are provided where the historic vegetation of the Upper River can be restored. Although altered by industrial use, fill, and construction, it is probable that underlying soils are still of a type that will most easily support oak savanna species, with a minimum of maintenance once established. Planting native species historically found on the Upper River will also restore the regional flavor of the place, creating an aesthetic effect and educational opportunity for visitors. Wildlife will be attracted to the habitat, with prairie plantings providing food and cover.

### Restoration Goals:

- Increase biodiversity of flora and fauna.
- Create quality wildlife habitat.
- Improve aesthetics of river corridor.



**Greenways**

In many respects the Upper River Parks Plan is based on a concept of the riverfront as a linear greenway. Studies in landscape ecology show the benefits of connected vegetated corridors to the survival of plant and animal species, because corridors allow species to move and disperse through a landscape, increasing resistance to disturbance events. Corridors enhanced with native plantings do not necessarily require a minimum width to be effective, nor do they have to have unbroken continuity of vegetation to be effective. In response to other urban design objectives, the Parks Plan allows varying levels of connectivity for species movement. Yet along all but the southernmost part of the Promenade, a continuous vegetated corridor at the river's edge is proposed for restoration. Within this greenway corridor, trail facilities should be complemented by a variety of restored landscapes.

**Design Guidelines to Meet Ecological Objectives**

- Integrate natural and human environments.
- Promote connectivity of vegetation.
- Target wildlife species.
- Use native plantings.
- Promote restoration on private and public land.
- Provide neighborhood involvement.
- Manage non-native species.

**Shoreland Buffer**

The most important zone within the greenway corridor is the shoreland, where the river and land meet. Designed in concert with riverbank restoration bioengineering techniques, plantings should be made at a preferred minimum width of 50 feet from the top of the bank. Wider areas can be accommodated in many areas for aesthetic variety and increased habitat diversity. A minimum strip of 50 feet will provide water quality benefits, by slowing and filtering water during storms, and will also provide a suitable wildlife habitat corridor. The riverbank and floodplain should be planted with species that thrive in soils that are periodically wet, including cottonwood, willow, and wetland grasses and forbs. This shoreland buffer will attract and benefit small mammal species and amphibians. Dispersal of plant and animal species along the restored bank will be facilitated, while overhanging trees will provide shade that cools water and provides in-stream structures for fish habitat. Along the shoreland, visitors might catch site of muskrat, heron, and frogs. Eagles too might find the Upper River attractive if the desired perches and fishing opportunities increase, while nest boxes placed near wetlands can be used to attract wood ducks.

**Open Space Plantings**

Large areas programmed for landscape-scale plantings, such as Restoration Park north of Lowry, provide an opportunity to recreate a semblance of the oak savanna that once dominated the banks of the Mississippi. White and burr oaks should be established in groups set within a short and tall grass prairie. These species will thrive in the sandy, dry soils and create an interesting landscape, blending at the Soo Line Bridge with North Mississippi



Regional Park. The oak savanna has much in common with traditional park designs, with both open areas and patches of trees.

Special plantings to attract butterflies or hummingbirds should be established, with informational signage explaining the location and ecological function of such areas within the park. Shorter grasses can be used under tree groupings to encourage use as informal picnic spots. Plantings should also be well designed in coordination with river views to insure that the best places for observing the river are not blocked by taller species. Trails should lead to special plantings, and places to observe the river or wildlife.

Desired wildlife species can be encouraged to nest in open spaces through the provision of their favorite plant forage or nest-making materials. Bird houses, for instance for blue birds and other song birds, can be placed in appropriate spots. Insect eaters, such as bats and purple martins, can also be attracted in the same way. Grasses are sure to bring mice, voles, and rabbits, who will in turn attract owls to nest in the taller trees. Peregrine falcon platforms can be constructed on taller buildings adjacent to the open spaces, reducing the populations of pigeons and small mammals. Perhaps red tail hawks will also circle above good hunting grounds.

**Constructed Wetlands**

The Water Filtration Parks, included as a major urban design component of the Master Plan, provide an excellent opportunity to construct wetlands as part of two-cell water-quality treatment ponds. Wetland plant species should be established in the emergent zone around wetlands constructed with shallow slopes. Deeper ponds may need to be fenced so that the safety of children is ensured, with thorny shrubs another option.

Gracefully water lilies, sedges, and bulrush will add much aesthetic and educational interest to wetland ponds. Wetland plantings will also filter and improve water quality, while providing habitat. Smaller-scale creatures, such as turtles, frogs, and waterbugs, can be found in the emergent zones, where water levels rise and fall. Larger species may also come to drink and forage.

**Geese and Deer**

White-tailed deer and Canada geese have adapted so well to urban environments that these two species can become a nuisance in the wrong areas. Geese are especially fond of the traditional mowed lawn areas with ready access to water bodies. Plantings of taller grasses and forbs at the water’s edge have proved effective in discouraging foraging by geese in parks. In the case of deer, the increased connectivity created by bank and landscape restoration will make migrations into the Upper River area more frequent. Periodic breaks in the linear greenway corridor will be beneficial in limiting the movement of larger mammals, especially in the southern sections of the Upper River closer to downtown.



**Maintenance and Safety**

Although periodic burning is the best way to maintain prairie plantings, this technique will most likely prove problematic given the urban location of the Upper River land. Alternative methods are available for annual mowing and brush removal when necessary. The first few years after planting are the most crucial for maintenance, while prairie plantings establish a thick system of roots that crowd out other volunteer species. Weeding or application of non-toxic herbicides will be necessary. Tree seedlings will also require protective tubes or fencing.

In addition to a different set of maintenance practices, naturalized landscapes must be designed so that the safety of visitors is not compromised by plantings which become overgrown. Trails through restored areas will need a shorter maintained edge, so that users can anticipate and avoid unwanted contact. Lighting and special safety measures, such as emergency phones, should be provided at regular points within park areas. Both visual and vehicular access for park police will need to be provided.

**Balancing Wildlife and Human Use**

In addition to wildlife, restoring the landscape along the banks of the Mississippi in Minneapolis will also attract people, and park design must consider how wildlife habitat can best be integrated with park facilities provided for human visitors. Trails through restored areas can be constructed of the traditional asphalt, but may also include porous surfaces in special areas. Observation areas should be created at critical junctions of ecosystem types, where shorelands blend with prairies, and where the different landscape zones, such as upland and lowland, can both be seen. Every effort should be made to utilize the new landscapes on the Upper River to educate visitors about the riverine ecology, as well as realize the potential for civilization to blend with natural landscapes and wildlife.

Indeed, the use of non-traditional plants, including native species, on landscaped building sites should be considered for redevelopment areas adjacent to riverfront parks. For instance, colorful prairie wildflowers and grasses, such as purple coneflower, black-eyed Susan, or bluestem, have been used with great success in business parks, and on residential lots. Backyard and sideyard corridors will provide varied habitat for many types of wildlife and provide value to residents. School and community groups participating in park maintenance, nest box construction, controlled burns, and other restoration activities will fully realize the potential for large-scale landscape renewal through concerted action.

Perhaps the real benefit of landscape restoration along the Upper River will be the ability of park users to experience the Mississippi River in a naturalized state. Spotting a muskrat, snake, or heron in a highly urbanized setting can be a thrilling moment, helping to connect city dwellers with the larger natural world. A real appreciation can develop when considering the true extent of the Mississippi's watershed and all of the living creatures that depend on the water flowing to and in the great river.



## Environmental Restoration Plan Conclusions

Water is essential to all life. As one of the great and critical waterways of the planet, the Mississippi River must be treated with respect and consideration of the long-term consequences of actions that alter its banks or pollute the adjacent land. An unquantifiable number of living creatures depend on the river for water, whether they live in the channel, along the banks, or in cities drawing drinking water. The Upper River in Minneapolis is only one 4-mile reach of a 2,470 mile long river—but it is no less important than any other place if the river is recognized as a flowing ecosystem. The Restoration Plan includes specific recommendations to restore the riverbanks along the Upper River, filter and cleanse the water entering the river from storm drains, and recreate a landscape that attracts, feeds, and shelters wildlife.

The Plan investigates known concentrations and types of soil and groundwater pollution. Planned conversion of land from industry to parks and residential uses will require a high level of cleanup. This remediation will be expensive, yet considering the location of the proposed redevelopment areas on the banks of the Mississippi, this is work that should be undertaken to protect the water supply irregardless of future uses.

Because the Upper River is an older urbanized area it is exempt from standards for stormwater retention that new development on greenfields are held to. Currently, there are no water quality ponds in the Upper River corridor. But the Upper River Master Plans recommends that redevelopment areas so close to the Mississippi should meet best-practice standards, and outlines specific areas for ponding and techniques for improving quality before water is allowed to flow to the river. A series of Water Filtration Parks are proposed, in which run-off can be retained and wetlands constructed.

Riverbank stabilization and restoration is highlighted by the Plan as a crucial component of improving the Upper River. Soil bioengineering techniques are recommended which utilize living plants to create structural stability on slopes through stems and the growth of root systems. A detailed analysis of existing bank conditions is given, leading to specific recommendations for the variety of different sites along the river.

In concert with bank stabilization, the Plan proposes park landscaping to recreate a semblance of the river corridor ecosystem prior to industrialization. Landscape restoration recommendations center on an oak savanna ecotype that the sandy soils of the Upper River support. Prairie plantings will attract, feed, and shelter a wide variety of insects, song birds, raptors, and small mammals. Park visitors will find a colorful riverscape that changes with the season.

All of the environmental restoration recommendations will improve the health, aesthetics, and provision of wildlife habitat in the Upper River corridor. The planning objectives in the area of ecological restoration are met by the Plan. The comprehensive nature of the Plan is displayed by the manner in which land-use, economic development and environmental recommendations all support each other. This is most evident in the area of barging, with the Plan recommending that heavy industry be phased out on the Upper River. As more scientific research is conducted on the effects of locks, dams, and barging on the Mississippi River it becomes clear that controlling water levels, channels, and flow to use the river as a transport canal is creating serious, long-term consequences to the river's ecology. While the debate about the expansion of locks and barging on the Upper Mississippi continues, the Upper River Master Plan argues that the area above the Falls of St. Anthony, the last barging pool in the system, is a place where barging can be discontinued, and the ecology of the river, its water, banks, and bed restored. It is most difficult to break the chain of locks and dams in the middle, but it can be shortened at its northernmost end, on the Upper River.

## **Recommendations Summary**

- Continue to monitor known sites of soil and groundwater contamination.
- Conduct extensive investigation of all sites with possible contamination before public acquisition.
- Cleanup contaminated soil and groundwater in the Upper River corridor.
- Install swales, basins, filters, and grit chambers to intercept and clean run-off.
- Construct a system of area-wide water-quality ponds that meet the highest standards for stormwater retention and filtration.
- Add amenities to stormwater ponding areas to create a system of Water Filtration Parks.
- Utilize soil bioengineering techniques to stabilize and revegetate banks and slopes along the Upper River.
- Create a vegetated shoreland buffer and wildlife habitat through landscape restoration techniques in new parks along the Upper River.